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TULARÆMIA Francis 1921.[1]

I. THE OCCURRENCE OF TULARÆMIA IN NATURE AS A DISEASE OF MAN.

By EDWARD FRANCIS, Surgeon, United States Public Health Service.

Tularæmia is a specific infectious disease due to *Bacterium tularense* and is transmitted from rodents to man by the bite of an infected blood-sucking insect or by the handling and dissection of infected rodents by market men [2] or laboratory workers.[3]

As observed in Utah in the months of June, July, and August, the disease is initiated by the bite of an insect, most probably the blood-sucking horsefly, *Chrysops discalis*, which previously has bitten a jack rabbit infected with *Bacterium tularense*. Following the fly bite on some exposed surface of the body (neck, face, hands, or legs), the onset is sudden, with pains and fever; the patient is prostrated and is confined to bed; the lymph glands which drain the bitten area become tender, inflamed, and swollen, and commonly suppurate, requiring incision. The fever is of a septic type, lasting from three to six weeks, and convalescence is slow.

Probably two dozen cases occurred in Millard County, Utah, in each of the years 1917, 1918, 1919, and 1920. The first case known to have terminated fatally was reported by the writer in 1919.[4] The chief interest in tularæmia as a disease of man arises from the disability which accompanies the illness; a disabling illness which overtakes the farmer in the busy season of midsummer, causing two or three months of sickness in the harvest season, is a serious matter. Tularæmia is a disease of the rural population, particularly attacking persons who work in the field. It occurs during the seasonal prevalence of the fly (*Chrysops discalis*) in a community where jack rabbits are dying from an epizootic of plaguelike disease of rodents.[5] The reservoir of infection is in the sick and dying jack rabbits.

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[1] The name tularæmia is based on the specific name *Bacterium tularense*, plus *æmia*, from the Greek, and has reference to the presence of this bacterium in the blood, on the analogy of leukæmia or bacteræmia, etc. The names thus far used for this disease are strictly vernacular and do not lend themselves to international usage as easily as a name in Latin form. Accordingly, the name tularæmia is proposed as a technical international name.

[2] Infection of man with *Bacterium tularense*. By William B. Wherry and B. H. Lamb. J. Infect. Dis, 1914, *15*, 331-340.

[3] Four cases in laboratory workers will be reported at a later date.

[4] Deer-fly fever: A disease of man of hitherto unknown etiology. By Edward Francis, Surgeon, United States Public Health Service. Public Health Reports, Sept. 12, 1919, pp. 2061-2062.

SEVEN CASES OF TULARÆMIA IN MILLARD COUNTY, UTAH.

A brief summary is given below of seven cases of tularæmia which the writer investigated clinically and culturally in Millard County, Utah, one in 1919 and six in 1920:

CASE 1.

R. S., male; 52 years of age; farmer; residence 7 miles southeast of Delta, Utah; patient of Dr. H. L. Charles, Delta.

July 23, 1919.—Patient was taken sick while mowing alfalfa; went to bed with fever, pains in head, neck, and right shoulder; wife saw a small sore on right side of neck posteriorly, but paid very little attention to it; patient remained in bed from this date until death.

July 26.—Temperature was 101° F. at 3 p. m. During the night of July 26 was sleepless on account of pain in head and right side of neck.

July 27.—Temperature normal at 1 p. m. A sore on right side of neck, posteriorly, showed a black center $\frac{1}{8}$ inch in diameter and surrounded by a yellow zone $\frac{1}{8}$ inch wide, which probably resulted from a fly bite, although patient did not recall having been bitten. Behind the right ear was a very tender and somewhat swollen area. No enlargement of axillary glands or of glands of left side of neck. Drew 65 c. c. of blood from median basilic vein for inoculation of animals.

July 28.—Temperature at noon, 100.5° F.

July 30.—Temperature at noon, 99.8° F. The appearance of the bite unchanged. Right cervical glands palpable, size of peas. Over the right mastoid, a swelling which fluctuates and is very tender and painful.

August 1.—Temperature 99° at 10 a. m., 101° at 6 p. m. Pain in neck has been severe during past two days. Some pus has exuded from the site of bite. Glands palpable. Swelling over mastoid very tender.

August 2.—Temperature a. m., 99°; p. m., 101°; pulse, 65. The black center of the bite has sloughed out and a few drops of pus exuded. A very tender swollen gland is palpable. Complains of great pain beneath the outer end of the right clavicle.

August 3.—Temperature a. m., 100°; p. m., 101°.

August 4.—Temperature a. m., 99°; p. m., 98.6°.

August 5.—Temperature a. m., 99°; p. m., 100°.

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[5] A plaguelike disease of rodents. By George W. McCoy, Passed Assistant Surgeon, United States Public Health Service. Public Health Bulletin No. 43, April, 1911.

Bacterium tularense, the cause of a plaguelike disease of rodents. By George W. McCoy and Charles W. Chapin, Passed Assistant Surgeons, United States Public Health Service. Public Health Bulletin No. 53, January, 1912.

August 6.—Temperature a. m., 99.2; p. m., 100°. Opened the abscess over the mastoid and got about 2 c. c. of pus, which was injected into animals. Drew 20 c. c. of blood from left median basilic vein, which was used for animal inoculations. Much pain in neck; patient said he had a chill yesterday.

August 7.—Temperature p. m., 101.6°.

August 8.—Temperature noon, 98.6°. The bite is the site of a hole which is exuding a little pus.

August 18.—Terminated fatally.

CASE 2.

W. E. C., male; age, 50 years; farmer; residence, 5 miles west of Holden, Utah; patient of Dr. John E. Fuhrer, Fillmore, Utah.

June 16, 1920.—Patient was taken sick while mowing alfalfa; he noticed a stinging and burning sensation above the left ear, but did not know whether or not he had been bitten; had headache and backache; had a chill and felt weak.

June 17–22.—Patient remained on farm unable to do any work.

June 23.—Went to Fillmore, Utah, to consult Dr. John E. Fuhrer, who reported a temperature of 100.6° F.; pulse, 76; white blood cells, 14,000. Examination showed a small crust in the hair of the left temple, about 1 inch above and 2 inches in front of the left ear, about the diameter of a match stick. The tissues were swollen and tender, and the lymph glands behind the ear and at the angle of the jaw were enlarged and very tender. Patient remained in bed from this date.

June 25.—Blood taken from median basilic vein for animal inoculations.

June 27.—Temperature, 99° F.; pulse, 76.

June 30.—Temperature, 98.6°.

July 2.—Temperature, 98.6°.

July 17.—Incised gland behind left ear and evacuated pus, which was used for animal inoculations.

July 21.—Incised gland at angle of left jaw and evacuated pus.

July 23.—Incised skin in front of left ear and evacuated pus. Site of bite on temple in hair has sloughed, leaving an ulcer three-quarters of an inch in diameter.

This patient recovered after an illness of about three months.

CASE 3.

J. T. G., male; age, 48 years; farmer; residence 7 miles northwest of Holden, Utah; patient of Dr. John E. Fuhrer.

June 27, 1920.—Patient became sick in the field while spading dirt about an irrigation ditch. First noticed a painful lump at the angle of the right jaw. Quit work and went to Holden with aching sensation through his body.

June 29.—Called Dr. John E. Fuhrer, who was the first to find the site of the bite, which was in the hair of the right temple, 1 inch above and 2 inches in front of the right ear. The patient had entirely overlooked the site of the bite, all of his attention having been directed to the painful gland at the angle of the jaw.

July 3.—Patient in bed with clothes on. The site of the bite has a black necrotic center. Glands at the angle of right jaw and behind the ear are much swollen, tender, and painful. Drew 30 c. c. blood from median basilic vein for animal inoculations.

Recovery was complete after an illness lasting about 10 weeks.

CASE 4.

M. S., male; age, 16 years; farmer; worked 1 mile west of Holden, Utah; patient of Dr. John E. Fuhrer.

June 23, 1920.—Bitten on the posterior surface of right ear while in the hay field.

June 24.—Had headache and felt badly and went to bed. Noticed a lump behind the right ear.

July 3.—The boy has been in bed most of the time for the past nine days. Temperature, 103°; pulse, 110. There is a punched out ulcer one-quarter of an inch in diameter on the posterior surface of the right ear. There is an enlarged gland behind the right ear over the mastoid, which is beginning to soften. Incised the gland and evacuated the pus, which was used to inoculate guinea pigs.

The patient recovered after an illness of about six weeks.

CASE 5.

Mrs. McK, female; age, 41 years; residence, 4 miles west of Holden, Utah, in the country; patient of Dr. W. B. Hamilton, of Delta, Utah.

June 16, 1920.—Patient was taken sick; she was not conscious that she had been bitten by a fly nor does she know whether a fly bit her or not.

July 2.—A suppurating gland located behind the right ear was incised and the pus used for inoculation of animals. About 30 c. c. of blood was drawn from the median basilic vein for the inoculation of animals. The site of the fly bite is plainly seen in the edge of the hair of the neck on the right side as a small scar.

Case recovered after a protracted illness lasting about three months.

CASE 6.

C. F., male; age, 30 years; resident of Meadows, Utah, 9 miles southwest of Fillmore; patient of Dr. John E. Fuhrer.

July 21, 1920.—First noticed glandular swelling under the right ear. The bite is apparent on the posterior surface of the right ear; did not know he was bitten at the time.

August 7.—Incised post-auricular gland on the right side, from which some bloody pus was obtained for the inoculation of laboratory animals.

The duration of illness was about six weeks; ended in recovery.

TABLE 1.—*Bacteriological confirmation of seven human cases of tularæmia in Millard County, Utah.*

Case.	Sex.	Age (years).	Occupation.	Date of onset.	Site of insect bite.	Site of suppurating lymph glands.	Blood from median basilic vein injected into guinea pigs.	Pus from suppurating lymph glands injected into guinea pigs.	Results in inoculated animals and in cultures from inoculated animals.
1. R. S........	Male....	52	Farmer..........	July 23, 1919	Right side of neck, posteriorly.	Right posterior auricular area.	July 27 and Aug. 6....	Aug. 6	Typical for *Bacterium tularense.*
2. W. E. C.....	...do.....	50	.....do............	June 16, 1920	Left temple in hair....	Left posterior auricular area; in front of left ear; at angle of jaw.	June 25...............	July 17	Do.
3. J. T. G.......	...do.....	48	.....do............	June 27, 1920	Right temple in hair..	Right posterior auricular area; at angle of right jaw.	July 3.................	....	Do.
4. M. S........	...do.....	16	.....do............	June 23, 1920	Posterior surface of right ear.	Right posterior auricular area.	....	July 3	Do.
5. McK.........	Female..	41	Wife of farmer.....	June 16, 1920	In hair of neck, right side.	.....do................	July 2.................	July 2	Do.
6. C. F........	Male....	30	(?)...............	July 21, 1920	Posterior surface of right ear.	.....do................	....	Aug. 7	Do.
7. Jackson......	Female..	7	Village resident...	Aug. 26, 1920	Posterior surface, lower third of right thigh.	Right inguinal region..	....	Sept. 9	Do.

CASE 7.

Jackson, female; age, 7 years; resident of Hinckley, Utah; patient of Dr. H. L. Charles, Delta, Utah.

September 9, 1920.—Patient came to the doctor's office with a bubo of the right inguineal region, which was fluctuating. By incision there was readily obtained some pus, which was used for the inoculation of laboratory animals. The site of the bite was on the posterior surface of the lower third of the right thigh, on that bare area so commonly seen above the stocking when a small girl bends forward; the bite had the appearance of a punched-out ulcer about a quarter of an inch in diameter.

Patient recovered.

TULARÆMIA IN JACK RABBITS.

The coexistence in the same locality of tularæmia in man and in jack rabbits was proved by the writer in June, July, and August, 1920, in Millard County, Utah. During this period, *Bacterium tularense* was isolated from 17 jack rabbits and 6 human cases.

A survey of jack rabbits for evidence of tularæmia was conducted throughout a stretch of irrigated farming country 60 miles in length, extending from Sugarville, Utah, which is approximately 35 miles northwest of Delta, to Fillmore, which is approximately 25 miles southeast of Delta. This survey began May 28 at Sugarville and ended June 18 at Fillmore. A total of 556 jack rabbits were shot and immediately dissected on the ground, examination being directed to their lymph glands, spleen, and liver. When the spleen and liver were considered suspicious, specimens were taken to the laboratory and rubbed on the abraded skin of the abdomen of a guinea pig; and in case of death of the guinea pig with typical lesions, cultures were made from the spleen and liver of the guinea pig. Twenty-three jack rabbits were found sufficiently suspicious by gross examination in the field to warrant inoculation of guinea pigs with their spleens and liver. Of these 23 jack rabbits, 17 were proved to be infected with *Bacterium tularense* in the laboratory by subinoculation in animals and by cultures; three jack rabbits which failed of confirmation in the laboratory were found dead in the field, and it is presumed that their infection had died before they reached the laboratory.

The jack rabbit survey, which ended June 18, outlined the district of most heavily infected jack rabbits and located it west of Holden. At this time no human cases had yet been reported for 1920, although it developed a few days later that two cases had had their onset on June 16 and that they lived west of Holden. The third and fourth cases of the season developed on June 23 and June 27; both worked west of Holden. All four cases occurred in the heart of the jack-rabbit-infected district, 5 miles west of Holden, where, on June 16, we located five infected jack rabbits and 26 jack rabbit carcasses.

TABLE II.—*Jack rabbits found infected with Bacterium tularense in Millard County, Utah.*

Date found.	Sex, age, or condition.	How taken.	Condition of spleen.	Condition of liver.	Condition of lymph glands of groin and axilla.	Where found.	"Positive" means confirmed by subinoculations and subcultures.	Remarks.
1920.								
June 1		Found dead	Spotted			2 miles south of Abrahams	Positive	
June 7	Pregnant	Shot running	do	Spotted	Negative	Near Sugarville	do	
June 11	do	Found dead	do	do	do	Maney ranch	do	
June 14	Female	Shot running	do	do	do	2 miles northwest of McCornick.	do	
Do	Pregnant	do	Negative	Few spots	do	do	Negative	
Do	Male	do	do	Spotted	do	do	Positive	
June 15	do	Found dead	Spotted	do	do	2 miles southwest of McCornick.	do	12 dried rabbit carcasses seen 2 miles southwest of McCornick, June 15. No specimens taken.
Do	Adult	do	do	do	do	do		
Do	Young	Shot running	Shattered	do	do	do	Positive	
Do	Pregnant	do	Spotted	do	do	do	do	
Do	Male adult	Found dead	3 spots	Negative	do	do	Negative	
June 16	Adult	Dead in road						
Do	Pregnant	Shot running	Spotted	Spotted	do	8 miles northwest of Holden	Positive	
Do	Adult	Found dead	do		do	5 miles west of Holden	do	26 dried carcasses of jack rabbits seen 5 miles west of Holden, June 16.
Do	Female	Shot running	do	Spotted	do	do	do	
Do	Pregnant	do	do	do	do	do	do	
Do	Young	Found dead	do	3 spots	do	do	Negative	
Do	Young female	Shot running	Negative	Spotted	do	do	Positive	
June 18	Young	do	Spotted	do	do	2 miles northwest of Fillmore	do	18 dried carcasses of jack rabbits seen 2 miles northwest of Fillmore, June 18.
Do	Adult	Dead in road	Large, no spots	do	do	do	Negative	
Do	Young	Shot running	Spotted	do	do	do	Positive	
Do	do	Found dead	do	do	do	do	do	
July 16		do	do	Negative	do	Blue Lake, 7 miles southwest of Hinckley.	do	

TULARÆMIA IN GROUND SQUIRRELS (*Citellus mollis*) IN UTAH.

During the jack rabbit survey referred to above, extending from Sugarville to Fillmore, 277 ground squirrels (*Citellus mollis*) were shot. These animals were immediately dissected on the ground for evidence of tularæmia. The livers and spleens of three were considered suspicious by gross examination and were brought to the laboratory for confirmation by guinea pig inoculations and cultures. One, which was shot June 2, 1 mile southwest of Abrahams, and had a typical spleen, proved positive, i. e., the spleen was rubbed on the abraded skin of the abdomen of a guinea pig and inoculated subcutaneously into another guinea pig; both pigs died with typical lesions of tularæmia, from which a culture of *Bacterium tularense* was obtained. The other two squirrels failed of confirmation in the laboratory.

Through the courtesy of Mr. W. C. Henderson, acting chief of the Bureau of Biological Survey, Department of Agriculture, specimens of *Citellus mollis* were determined.

II. EXPERIMENTAL TRANSMISSION OF TULARÆMIA BY FLIES OF THE SPECIES CHRYSOPS DISCALIS.

By EDWARD FRANCIS, Surgeon, and BRUCE MAYNE, Associate Sanitarian, United States Public Health Service.

A study of tularæmia in Millard County, Utah, in 1920, by one of us (Francis) proved the coexistence in the same locality of human cases of this disease and of a fatal epidemic in jack rabbits, both due to *Bacterium tularense*. Further studies showed a much greater prevalence of *Chrysops discalis* (a blood-sucking horsefly) in these infected localities than in noninfected localities. It was well known that *Chrysops discalis* bites man. Popular belief had connected the occurrence of human cases of tularæmia with the bites of *Chrysops discalis*. No data were at hand, nor did we elicit any, bearing on the question of whether *Chrysops discalis* bites jack rabbits in nature, but we assume that they do and especially if the jack rabbits are in sick or dying condition and thus oblivious to biting flies. A prerequisite to the conveyance of the infection from jack rabbit to man by a blood-sucking fly is the presence of the causative organism in the rabbit's peripheral blood. McCoy [1] had already shown that the heart's blood of animals experimentally infected with *Bacterium tularense* was infective even after great dilution when injected into fresh laboratory animals. Francis had isolated this organism from the peripheral blood of two human cases. The bacteræmia characteristic of the disease thus afforded the necessary condition for transference by a blood-sucking fly.

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[1] A Plague-like Disease of Rodents (Public Health Bulletin No. 43). By George W. McCoy, Passed Assistant Surgeon, United States Public Health Service. 1911.

We decided to test the question of whether *Chrysops discalis* was capable by its bite of carrying the infection of *Bacterium tularense* from an infected laboratory animal to a healthy laboratory animal. The experiments which we are about to report show that specimens of *Chrysops discalis* which have first bitten infected guinea pigs and tame rabbits in a laboratory can by their subsequent bites convey that infection to healthy guinea pigs and tame rabbits which they are allowed to bite. We therefore draw the conclusion that *Chrysops discalis* is capable of carrying the infection of *Bacterium tularense* in nature from infected jack rabbits to man.

EXPERIMENTAL TRANSMISSION BY THE FLY (*Chrysops discalis*).

The specimens of *Chrysops discalis* used were female adult insects, captured in nature on horses near Blue Lake, Utah, a locality in which three human cases of tularæmia (diagnosed clinically) occurred in 1920 and in which one jack rabbit was found infected with *Bacterium tularense.* Our transmission experiments are therefore open to the criticism that the *Chrysops discalis* which we used had an opportunity of becoming infected in nature before being brought into captivity in the laboratory. If this were true, however, it would only give added weight to the evidence of the agency of *Chrysops discalis* as a transmitter of tularæmia.

Each fly under experiment was confined singly at all times within a lantern globe, the ends of which were covered with cloth gauze of coarse mesh. Biting was permitted by applying the end of the globe to the animal's skin, the fly biting through the meshes of the gauze. When not actually biting, the flies were kept in the cold room at a temperature of approximately 15° to 20° C.

The experiments were conducted in the summer of 1920, at Delta, Utah, a town 150 miles south of Salt Lake City. The guinea pigs and rabbits used in these experiments were shipped from Washington, D. C., to Delta. In the transmission experiments we used, four human strains of *Bacterium tularense* which one of us (Francis) had isolated in 1920 from four human cases of tularæmia in Utah.

We are indebted to Dr. J. M. Aldrich, of the division of insects of the National Museum for determining specimens of *Chrysops discalis.*

Table II shows the essential data connected with 11 successful transmissions of *Bacterium tularense* from infected laboratory animals to healthy laboratory animals through the agency of the bites of *Chrysops discalis.* Twenty-seven unsuccessful attempts were made which are not reported in this paper. The unsuccessful experiments were conducted according to the same methods as were the 11 successful ones. No specific reason can be given for the failure of any experiment. In this connection it is very interesting to note Experiment No. 1, in which, out of five flies which fed at the same time on the same infected rabbit, only one was found to be either infective or infected. The other four were found to be neither infective nor infected.

EXPERIMENT NO. 1.

In this experiment a single fly by a single bite caused the death of a guinea pig with typical lesions due to *Bacterium tularense,* the interval which elapsed between biting the infected rabbit and the healthy guinea pig being only a few seconds and the interval between biting the healthy guinea pig and the death of this animal being seven days.

Flies Nos. 1, 2, 3, 4, and 5, fed August 14, 1920, during 5, 5, 6, 6, and 10 minutes, respectively, to partial engorgement on the clipped skin of the region of the crest of the ilium of a rabbit six days after its inoculation and two and one-half hours before death; and then, after an interval of only a few seconds, each fly bit to engorgement one of five guinea pigs, on the clipped skin on the region of the crest of the left ilium, for the period of 15, 15, 15, 6, and 25 minutes, respectively. The guinea pigs all remained well except the one which was bitten by fly No. 5; this one died August 21. At autopsy there were the typical lesions due to *Bacterium tularense* in the left inguinal gland, pelvic gland, liver, and spleen. A piece of the spleen of the guinea pig was rubbed on the scarified shaven abdomen of another guinea pig, causing death in four days with typical buboes, spleen, and liver.

Inasmuch as only one of the five flies infected its guinea pig, the infectivity of all of the flies was tested as follows; the flies were dissected and the stomach contents of each were injected subcutaneously into a guinea pig.

Fly No. 1.—Stomach contents injected August 16, two days after biting the infected donor. Guinea pig remained well.

Fly No. 2.—Stomach contents injected August 16, two days after biting the infected donor. Guinea pig remained well.

Fly No. 3.—Stomach contents injected August 17, three days after biting the infected donor. Guinea pig died August 21. Negative.

Fly No. 4.—Stomach contents injected August 17, three days after biting the infected donor. Guinea pig remained well.

Fly No. 5.—Stomach contents injected August 18, four days after biting the infected donor. Guinea pig died August 23, with typical lesions of spleen, liver, and lymph glands due to *Bacterium tularense.*

EXPERIMENT 2.

In this experiment 6 flies, by 6 bites (1 each) caused the death of guinea pig No. 10 with typical lesions of tularæmia, the interval between the biting of the infected guinea pig and the healthy guinea pig being only a few seconds, and the time between the biting of the healthy guinea pig and the death of same being 5 days. The 6 flies fed to partial engorgement on August 25 during 2, 7, 12, 2, 9, and 14 minutes, respectively, on the ear of infected guinea pig No. 8, 4 days after inoculation and 2 to 5 hours before death; and then, after an interval of only a few seconds, they fed to engorgement on guinea pig No. 10, upon the clipped skin of the region of the crest of the ilium, for the periods of 20, 3, 14, 2, 10, and 16 minutes, respectively. Guinea pig No. 10 died August 30. At autopsy the glands and liver were apparently negative, but the spleen, being suspicious, was used to inoculate two guinea pigs subcutaneously. These guinea pigs died September 2 with typical inguinal and pelvic glands and typical livers and spleens. The virus was passed through three subsequent generations in guinea pigs, these animals dying with typical lesions on Sept. 6, 10, and 16. The method of inoculation was that of rubbing spleen tissue on the shaven, abraded skin of the abdomen of the guinea pig.

EXPERIMENT 3.

In this experiment 11 flies, by 11 bites (1 each), caused the death of guinea pig No. 11, with typical lesions of tularæmia, the interval between the biting of the infected rabbits and the healthy guinea pig being only a few seconds, and the interval between biting the healthy guinea pig and the pig's death being 6 or 7 days. Six flies fed to partial engorgement (3 on Aug. 25 and 3 on Aug. 26) for 4, 4, 5, 6, 5, and 5 minutes, respectively, on the ear of infected rabbit C, 33, 31, 30, 9, 8, and 6 hours, respectively, before its death. Five other flies fed to partial engorgement (1 on Aug. 25, and 4 on Aug. 26) for 2, 10, 5, 1, and 16 minutes, respectively, on the ear of infected rabbit G, 22, 8, 2, 1, and ¼ hours, respectively, before its death. After an interval of only a few seconds, the 11 flies fed to engorgement on guinea pig No. 11, on being applied to the clipped skin of the region of the crest of the right ilium for the periods of 42, 10, 40, 3, 4, 25, 5, 24, 20, 1, and 16 minutes, respectively. Guinea pig No. 11 died September 1, with typical lesions of the right inguinal gland, spleen, and liver. There was a slight local reaction at the site of the fly bites, consisting of a little redness and thickening of the skin. The infection was carried through two subsequent generations in guinea pigs by rubbing spleen tissue on the shaven abraded skin of the abdomen of guinea pigs. The pigs died September 5 and 12 with typical lesions of tularæmia.

EXPERIMENT 4.

In this experiment, 16 flies by 16 bites (1 each), caused fatal tularæmia in guinea pig No. 13, the interval between the biting of the infected guinea pigs and the healthy guinea pig being only a few seconds and the time between biting the healthy guinea pig and the death of same being 6 or 7 days. Sixteen flies fed to partial engorgement for an average period of 7 minutes on the ears of infected guinea pigs Nos. 9, 10, 11, and 12, the pigs being in the latter stages of the disease, and after an interval of only a few seconds they fed to engorgement for an average period of 7 minutes on the clipped skin of the region of the crest of the right ilium of guinea pig No. 13. This pig was found dead September 6 with typical inguinal glands on the right side only (left inguinal glands negative) and typical liver and spleen; the site of the fly bites showed a slight pale thickening of the skin.

The infection was carried through two subsequent generations in guinea pigs by rubbing spleen tissue on the clipped, abraded skin of the abdomen of guinea pigs. The pigs died with typical lesions September 10 and 15.

EXPERIMENTS 5 AND 6.

In experiment No. 5, 22 flies by 340 bites, caused the death of guinea pig No. 5, with typical tularæmia, and in experiment No. 6, 20 flies by 348 interrupted bites, caused the death of rabbit No. 8. These were the first transmission experiments which we performed; they were preliminary, and therefore large numbers of bites were employed, the object being to determine whether the fly acted even remotely in the role of the carrier of the infection. The method of fly biting in these experiments differed from that recorded in experiments 1, 2, 3, and 4, in that the flies were never allowed to bite longer than from 30 to 60 seconds. For instance, a given fly was allowed to bite from 30 to 60 seconds on the clipped skin of the region of the crest of the ilium of the infected animal and then was immediately applied for from 30 to 60 seconds to the clipped skin of the region of the crest of the ilium of the healthy animal, and this was repeated, the fly alternately biting the infected and healthy animal until it reached engorgement. Another fly would then be taken through the same process. This method of biting accounts for the large numbers of bites recorded in experiments 5 and 6, each fly biting the healthy animal an average of 16 times for an average of about 45 seconds each time.

Guinea pig No. 5 was dead August 2. The site of the fly bites showed hemorrhagic points on the underside of the skin; three inguinal glands were caseous on the side of the fly bites, but the inguinal glands on the opposite side were negative; pelvic glands were caseous; liver and spleen were typical. The infection was carried over by rubbing a piece of spleen on the clipped, abraded skin of the abdomen of a guinea pig and a rabbit. These animals died with typical lesions on August 5 and 6.

Rabbit No. 8 was dead August 8. The site of the fly bites was negative; inguinal and axillary glands were negative; pelvic glands, substernal glands, liver, spleen, and lungs showed typical lesions of tularæmia. The infection was carried over by rubbing a piece of spleen on the clipped, abraded skin of the abdomen of a guinea pig and rabbit. These animals died with typical lesions August 12 and 13.

EXPERIMENTS 7, 8, AND 10.

In Experiments Nos. 7, 8, and 10 the interval between the biting of the infected animal and the healthy animal was extended to 1 hour, 3 hours, and 24 hours, respectively. Large numbers of flies were used and they bit a great number of times. In these experiments, as in Experiments Nos. 5 and 6, the flies were interrupted in their biting, being allowed to bite only from 30 to 60 seconds at a time and being made to bite alternately the infected and the healthy animal on the clipped skin in the region of the crest of the ilium. Each fly bit the infected and healthy animals in Experiment No. 7 an average of about four times each; in Experiment No. 8 an average of about two times each; and in Experiment No. 10 only once. Transmission was successful in the three experiments, rabbits Nos. 9, 10, and 11 dying with typical lesions of tularæmia. Rabbit No. 9 showed no enlargement of the inguinal or axillary glands, but showed typical lesions of the pelvic glands, liver, and spleen. The virus was carried over to another rabbit and a guinea pig by rubbing the spleen on the abraded surface of the abdomen of those animals. Death followed in 6 days, with typical lesions of the inguinal and pelvic glands, liver, and spleen.

Rabbit No. 10 showed no enlargement of the inguinal glands, but showed typical pelvic glands, liver, and spleen. The infection was carried over to a guinea pig by rubbing the spleen on the abraded skin of the abdomen of the pig, resulting in death in 5 days, with typical lesions of the inguinal and pelvic glands, liver, and spleen. Rabbit No. 11 showed no enlargement of inguinal or axillary glands, but the pelvic glands on the right side were typicial, as were also the liver and spleen. The local reaction of the skin at the site of the fly bites over the crest of the right ilium was marked; the skin for an area 1 inch in diameter was raised and thickened, but perfectly movable over the fascia covering the muscle; and on section, this skin was pale, thick, and membranous.

EXPERIMENT 9.

In Experiment No. 9, 10 flies, by 10 bites (1 each), caused fatal tularæmia in a rabbit, the intervals between the biting of the infected guinea pigs and the healthy rabbit being 5 to 72 hours. The average time of biting the infected animals on the ear, to partial engorgement, was 5 minutes, and the average time of biting the healthy rabbit, to complete engorgement, on the clipped skin of the area of the crest of the ilium, was 8 minutes. At autopsy the rabbit showed typical inguinal and pelvic glands, spleen, and liver. The infection was carried over to another animal by rubbing a piece of the spleen on the abraded skin of the abdomen, resulting in death in 4 days, with typical lesions of the inguinal, pelvic, and axillary glands and the liver and spleen.

EXPERIMENT 11.

In this experiment, 24 flies, by 41 bites, caused fatal tularæmia in a rabbit, the intervals between the biting of the infected guinea pigs and rabbits and the biting of the healthy rabbit being 4 to 16 days. The average time of feeding the flies to partial engorgement on the ears of the infected animals was 5 minutes and the average time of feeding the flies to full engorgement on the clipped skin on the region of the crest of the ilium of the healthy rabbit was 9½ minutes. The rabbit died with typical lesions of the spleen, liver, and lungs, and showed a local lesion of the skin, consisting of a papule one-fourth inch in diameter on the right hip, posterior to the crest of the ilium, which was movable, hard, and which, on section, was hard, white, and not broken down. The pelvic glands on the right side were much enlarged and caseous, whereas those on the left side were negative, as were also the inguinal glands on both sides.

The infection was carried over for two generations in rabbits by rubbing a portion of the spleen on the abraded skin of the abdomen, both animals dying with typical lesions of inguinal and pelvic glands, liver, and spleen after 5 and 6 days, respectively.

LENGTH OF TIME THAT CHRYSOPS DISCALIS WILL REMAIN INFECTED.

This question was answered in two ways: First, by noting among the 11 experiments in which tularæmia was successfully transmitted by *Chrysops discalis* the longest interval which elapsed between the bite which infected the fly and the subsequent bite by which that fly infected a healthy animal, 4 days being the longest successful interval noted; second, by injecting infected flies subcutaneously into guinea pigs, the flies having been kept for various lengths of time after becoming infected by biting an infected animal.

Flies which had bitten infected animals were kept at an average temperature of 15° to 20° C., and on each succeeding day from 1 to 15 days one or more flies were killed, their wings and legs discarded, and the entire fly was ground in a mortar with normal saline solution and the suspension injected subcutaneously into a guinea pig.

The longest interval of time that such a fly remained infected, as evidenced by the death of the guinea pig with typical lesions of tularæmia, was 14 days.

In all, 44 injections were made of 99 flies which had been kept for various periods after biting infected animals. The following table gives the results. Up to 5 days the flies remained quite constantly infected. The longer the flies were kept, the less tendency they showed to be infected. This would indicate probably that the virus does not multiply within the fly, but that *Chrysops discalis* acts merely in a mechanical way as a transmitter of tularæmia.

TABLE I.—*The length of time that Chrysops discalis remained infected as shown by injection of flies into guinea pigs.*

Number of days between biting the infected animals and being injected into a healthy guinea pig.	Number of flies injected into 1 guinea pig.	Results. ("Positive" means death of guinea pig with typical lesions of tularæmia.)	Number of days between biting the infected animals and being injected into a healthy guinea pig.	Number of flies injected into 1 guinea pig.	Results. ("Positive" means death of guinea pig with typical lesions of tularæmia.)
1	3	Negative.	8	2	Positive.
2	4	Positive.	8	2	Negative.
2	1	Do.	8	2	Positive.
2	3	Do.	8	1	Do.
2	8	Do.	9	1	Negative.
2	3	Do.	9	1	Do.
2	2	Do.	9	1	Positive.
2	1	Negative.	10	4	Do.
2	1	Do.	10	2	Negative.
3	2	Positive.	10	5	Do.
3	5	Do.	10	6	Do.
3	3	Do.	10	1	Do.
3	1	Do.	10	1	Do.
3	1	Negative.	12	2	Do.
4	4	Positive.	12	1	Do.
4	1	Do.	12	1	Do.
4	2	Do.	12	1	Do.
4	1	Do.	12	1	Do.
5	4	Do.	13	2	Do.
5	3	Negative.	14	2	Positive.
5	1	Positive.	15	1	Negative.
6	4	Do.	15	1	Do.

TABLE II.—*Successful transmission of tularæmia in the laboratory from inoculated animals to healthy animals by the bites of Chrysops discalis.*

Number of experiment.	Inoculated animal which flies were allowed to bite and thus become infected.	Length of time between inoculation of animal and death of same.	Length of time between the biting of the infected animal by the fly and death of animal.	Number of flies which bit infected animal and then bit healthy animal.	Number of times that infected flies bit healthy animal.	Length of time between biting infected animal and biting healthy animal.	Dates on which infected flies bit healthy animal.	Healthy animals which the infected flies were allowed to bite.	Results. "Positive" means death from tularæmia.
		Days.	*Hours.*				1920.		
1	Rabbit	6	2½	1	1	Few seconds	Aug. 14	Guinea pig	Positive; died Aug. 21.
2	Guinea pig No. 8	4	2–5	6	6	do	Aug. 25	Guinea pig No. 10.	Positive; died Aug. 30.
3	Rabbit C	4½	33, 31, 30, 9, 8, 6	6	6	do	Aug. 25 or 26	Guinea pig No. 11.	Positive; died Sept. 1.
	Rabbit G	4	22, 8, 2, 1, ¼	5	5	do	do	do	
4	Guinea pig No. 9	5	22–24	3	3	do	Aug. 30 or 31	Guinea pig No. 13.	Positive; died Sept. 6.
	Guinea pig No. 10	5	[1] 5	1	1	do	do	do	
	Guinea pig No. 11	6, 7	17–43	11	11	do	do	do	
	Guinea pig No. 12	4	[1] 15	1	1	do	do	do	
5	Rabbit No. 3			22	340	do	July	Guinea pig No. 5	Positive; died Aug. 2.
6	Rabbits			20	348	do	August	Rabbit No. 8	Positive; died Aug. 8.
7	do			51	207	One hour	August	Rabbit No. 9	Do.
8	do			23	33	3 hours	Aug. 8	Rabbit No. 10	Positive; died Aug. 15.
				31	55	do	Aug. 9	do	
				26	51	do	Aug. 10	do	
				34	74	do	Aug. 11	do	
				36	73	do	Aug. 12	do	
9	Guinea pig No. 13	6, 7	60, 60, 36	3	3	3 days	Sept. 5, 7, 8, 9, or 10.	Rabbit	Positive; died Sept. 16.
	Guinea pig No. 14	7	3	1	1	do	do	do	
	Guinea pig No. 15	5	8	3	3	do	do	do	
	Guinea pig (yellow)			3	3	5 hours	do	do	
10	Rabbit McK		3	29	29	24 hours	Aug. 13	Rabbit No. 11	Positive; died Aug. 23.
	Rabbit G	5	51	39	39	do	Aug. 14	do	
	do	5	27	45	45	do	Aug. 15	do	
	Rabbit S		26	25	25	do	Aug. 16	do	
	Rabbit McK	4	48	37	37	do	Aug. 17	do	
	Rabbit C	4	30	38	38	do	Aug. 18	do	
	Rabbit			35	35	do	Aug. 19	do	
11	Guinea pigs 7, 10, 11, 13; eight rabbits.			24	41	4–16 days	Sept. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 13.	Rabbit	Positive; died Sept. 14.

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[1] Minutes.

III. EXPERIMENTAL TRANSMISSION OF TULARÆMIA IN RABBITS BY THE RABBIT LOUSE, HÆMODIPSUS VENTRICOSUS (DENNY).

By EDWARD FRANCIS, Surgeon, and G. C. LAKE, Passed Assistant Surgeon, United States Public Health Service.

The experiments here reported show that the common rabbit louse, *Hæmodipsus ventricosus* (Denny), when taken from rabbits which have died with the typical lesions of tularæmia and placed in the hair of healthy rabbits causes the death of the latter with typical tularæmia.

Experiments which we conducted in the Hygienic Laboratory between February 3 and May 16, 1921, showed that healthy tame rabbits in contact with rabbits inoculated intraperitoneally with heart's blood of infected rabbits died typically from tularæmia. Forty-three such positive results were obtained. The conditions of contact were that one inoculated rabbit and two healthy rabbits were confined in each compartment, the diameter of which was about 18 inches. These compartments were glass aquarium jars, galvanized-iron garbage cans, or well-ventilated wire cages. In determining the means of transmission in these cases, consideration was given to insects and to the infectivity of nasal secretions and urine.

INFECTIVITY OF NASAL SECRETIONS OF RABBITS.

It was found that the nasal washings from infected rabbits, when dropped into the nares of healthy rabbits or injected subcutaneously into guinea pigs, produced the disease. Of 17 specimens of nasal washings obtained from 17 infected rabbits, 9 were infective, as shown by the death from tularæmia of healthy rabbits into whose nares these washings were dropped; and of 24 specimens of nasal secretions obtained from 24 infected rabbits, 21 were infective, as shown by the death from tularæmia of healthy guinea pigs into which these washings were injected subcutaneously.

INFECTIVITY OF URINE OF RABBITS.

Four specimens of urine, two from rabbits dead of tularæmia and two from rabbits sick with the disease, injected subcutaneously into guinea pigs, caused the death of the pigs with typical lesions of tularæmia. A fifth specimen from a rabbit dead of tularæmia gave negative results. The amounts injected varied from 0.05 to 5 c. c. Precautions were taken to prevent the presence of blood in the specimens.

It was found impossible, however, to infect four rabbits and two guinea pigs by mixing with their food large quantities of nasal washings or urine from infected rabbits, although they ate the mixture readily. This latter result made it doubtful whether the 43 positive results referred to above were due either to droplet infection or urine.

A constant watch for fleas has been kept with the result that only three were found in the laboratory during the eight months period ending in July, 1921. McCoy and Chapin had reported one successful experiment on the transmission of the infection from squirrel to squirrel by fleas (*C. acutus*).

INFESTATION OF RABBITS WITH LICE.

No systematic search was made for lice upon rabbits in the Hygienic Laboratory until early in May, when one was accidentally found. Since that time some lice have been found on every rabbit that has been carefully examined. Usually only a few are present, and careful search is required to find them; but occasionally they are present in large numbers. Most of them are found over the lumbar region, either on the skin or clinging to the butt ends of the hair.

The presence of blood-sucking lice immediately opened the question as to whether the large number of successful contact infections obtained between February 3 and May 16 may not have been due in part or entirely to this cause. It was therefore decided (1) to conduct experiments to determine whether the louse could readily carry the infection from rabbit to rabbit and (2) to repeat the contact experiments, using only carefully deloused animals. The results of (1) are quite conclusive and are the subject of this paper. The results of (2) will be reported later.

EXPERIMENTAL TRANSMISSION BY LICE.

Experiments upon the agency of lice in the transmission of tularæmia were carried out as follows:

As soon as possible after the death of an infected rabbit its hair was pulled out over the lumbar and sacral regions, and, since the lice cling to the butts of the hairs, the butts were clipped off with a scissors and transferred to a glass jar. In most instances the infested hair was immediately transferred to the hair of a healthy rabbit, but in other instances an interval of one, two, or three days was allowed to elapse between the removal of lice from the infected rabbit and their transfer to a healthy rabbit. The louse-infested hair was applied to the hair of the lumbar region of a healthy rabbit and overlaid with two layers of gauze, the margins of which were held down by adhesive tape to hold the hair in place. The gauze and adhesive were removed on the following morning, care being taken not to injure the animal's skin in loosening the tape, which was done by cutting off a little of the hair. The rabbits were placed at once in thoroughly cleaned tall ash cans, a single rabbit to each can, and a ring of vaseline was placed around the inside, about 6 inches from the top.

GUINEA PIGS IN CONTACT WITH RABBITS.

In 22 cases a healthy guinea pig was placed in the can with the infested rabbit in order to determine whether the guinea pig would develop tularæmia from contact with the rabbit. These guinea pigs all remained negative with the exception of five which were in contact with rabbits infested with lice removed from rabbit S 62 R; four of these died in from seven to nine days with typical lesions of tularæmia; the fifth died with typical lesions after 26 days. These five guinea pigs were all searched at the moment of death for rabbit lice, their hair being pulled out and examined. On one there were five dead rabbit lice; on another, there were six dead rabbit lice; on the other three guinea pigs none could be found. Of the 17 guinea pigs which remained well, 11 were in contact with infested rabbits which died typically of tularæmia, and six were in contact with infested rabbits which failed to contract tularæmia.

STRAINS OF TULARÆMIA USED.

The strains of tularæmia used in these experiments were five strains isolated by Francis in 1920 from human cases in Utah, and one California ground squirrel strain isolated by Passed Assistant Surgeon W. T. Harrison in San Francisco in 1920.

RESULTS.

The following results were obtained:

First series.—In this series, transmission of tularæmia to healthy rabbits was effected by the transfer to them of lice removed from rabbits dead after intraperitoneal inoculation with heart's blood from infected animals. Sixteen healthy rabbits were thus infested, the number of lice used for each rabbit varying from 28 to several hundred. Eleven of the 16 died with typical tularæmia. In these 11 cases the interval which elapsed between the removal of lice from the infected rabbit and their application to the healthy rabbit was at most only a few hours, and the intervals which elapsed between the infestation of the healthy rabbits and their deaths varied from 8 to 25 days, the average being 11.7 days. Five rabbits of this series remained negative. In two of these, intervals of 24 hours and two days, respectively, were allowed to elapse between the removal of lice from the infected rabbits and their application to the healthy rabbits. No explanation is offered for the three negative ones in which no such interval was interposed.

Second series.—Transmission of tularæmia was effected by lice transferred from the first series of louse-infected rabbits to healthy rabbits. Seven healthy rabbits were thus infested, the number o lice used for each rabbit varying from 70 to 300. Six of the seven rabbits died with typical tularæmia. In four of these six cases, the interval which elapsed between the removal of lice from the infected rabbit and their application to the healthy rabbit was less than three hours; in the fifth case (R L 18) the interval was two days, during which time the lice were allowed to feed on a healthy rabbit, R L 15, which died of pneumonia on the second day. In the sixth case (R L 23) the interval was three days.

Third series.—Transmission of tularæmia was effected by lice transferred from the second series of louse-infected rabbits to healthy rabbits. Four rabbits were thus infested. The first died with typical lesions 18 days after infestation; the second died with typical lesions 13 days after infestation; the third died 13 days after infestation (and in this case only 17 lice were applied and an interval of 3 days had elapsed between the removal of the lice from the infected rabbit and their application to the healthy rabbit); the fourth at the time of this report, 30 days after infestation, is still well, only four lice having been used for the infestation.

Fourth series.—Lice were transferred from louse-infected rabbits of the third series to healthy rabbits. Two rabbits were thus infested and both are still well (at the time of this report) on the twenty-ninth and thirtieth days, respectively, after infestation. One of them was infested with 20 lice which had been kept 3 days after removal from the infected rabbit before application to the healthy rabbit; the other was infested with 20 lice 3 hours after removal from the infected rabbit.

SUMMARY.

The transmission of tularæmia was effected in 20 out of 29 attempts through the agency of the common rabbit louse (*Hæmodipsus ventricosus*), by the transfer of lice from rabbits dead of tularæmia to the hair of healthy rabbits, the intervals elapsing between infestation of the healthy rabbits and their deaths varying from 8 to 26 days, the average being 12½ days. The intervals between the removal of lice from the infected animals and their application to the healthy animals were in all successful attempts not over three hours, with three exceptions, in which the interval was 2, 3, and 3 days, respectively.

Transmission of tularæmia was effected through three successive series of rabbits by transfer of lice to each succeeding series from the preceding series.

CONCLUSION.

The practical importance of this experimental transmission of tularæmia from infected rabbits to healthy rabbits by the rabbit louse *Hæmodipsus ventricosus* is that it offers an explanation of the means by which the infection is kept alive throughout the year in the jack rabbits of Utah. Proof is at present complete that these jack rabbits are infested with lice, four specimens of *Hæmodipsus ventricosus* having been received from that source in July, 1921.

Acknowledgment.—Through the courtesy of Dr. L. O. Howard, Chief of the Bureau of Entomology, Department of Agriculture, the determination of specimens of *Hæmodipsus ventricosus* was made by Dr. H. E. Ewing, of that Bureau.

Transmission of tularæmia in rabbits by Hæmodipsus ventricosus.

Series.	Number of experiment.	Infected animals from which lice were removed.			Interval which elapsed between removal of lice from infected animals and transfer to healthy animal.	Healthy animal to which lice were transferred.	Number of days between infestation with lice and death of rabbit.	Date of death of infested rabbit.	Result. "Positive" means death from tularæmia.
		Number of animal.	Date found dead from tularæmia.	Approximate number of lice removed.					
First series: Transmission was effected by lice transferred from inoculated rabbits to healthy rabbits.	1	SF 34 R	May 28, 1 p. m.	36	Less than 15 minutes	RL 1	15	June 12	Positive.
		McK 66 R	May 29	4	do	do			
	2	S 59 R	May 22	15	do	RL 2	9	May 31	Do.
		S 60 R	May 27, 3 p. m.	13	do	do			
	3	C 65 R	May 27, 1 p. m.	80	About 2 hours	RL 3			Negative, July 27.
	4	S 62 R	June 7	180	From 1 to 3 hours	RL 6	8	June 15	Positive.
		do	do	180	do	RL 7	16	June 23	Do.
		do	do	180	do	RL 8	11	June 18	Do.
		do	do	180	do	RL 9	9	June 16	Do.
		do	do	180	do	RL 10	9	do	Do.
		do	do	180	do	RL 11	8	June 15	Do.
	5	SF 36 R	June 8, 2 p. m.	100	Not over 2 hours	RL 12			Negative, July 27.
	6	J 57 R	June 6	70	About 1 hour	J 58 R	11	June 17	Positive.
	7	McK 67 R	June 5	500	Less than 3 hours	RL 13 A	25	June 30	Do.
	8	SF 37 R	June 10, 1 p. m.	300	2 to 3 hours	RL 13	8	June 18	Do.
	9	C 67 R	June 13, 1 p. m.	200	Not over 3 hours	RL 20			Negative, July 27.
	10	UF 1	June 19	25	24 hours	RL 21			Do.
	11	G 14 R	do	200	2 days	RL 22			Do.
Second series: Transmission was effected by lice transferred from louse-infected rabbits of first series to healthy rabbits.	12	RL 2	May 31	50	2 to 3 hours	RL 4	11	June 11	Positive.
		do	do	50	do	RL 5	15	June 15	Do.
	13	RL 6	June 15	180	1 to 4 hours	RL 15	2	June 17	Negative.[1]
		RL 11	do	130	do	do			
					2 days during which lice were on RL 15.	RL 18	9	June 26	Positive.
	14	RL 9	June 16	120	Not over 3 hours	RL 16	26	July 12	Do.
		RL 10	June 16, 9 a. m.	160	do	do			
	15	J 58 R	June 17	70	Not over 2 hours	RL 19	11	June 28	Do.
	16	RL 8	June 18	150	3 days	RL 23	18	July 16	Do.

Third series: Transmission was effected by lice transferred from second series of louse-infected rabbits to healthy rabbits.	17	RL 4	June 11	100	Not over 2 hours	RL 14	18	June 29	Positive.
	18	RL 5	June 15	200	Not over 3 hours	RL 17	13	June 28	Do.
	19	RL 18	June 26, 6 a. m.	30	3 days, after which 17 remained alive.	RL 25	13	July 12	Do.
	20	RL 19	June 28, 6 a. m.	4	About 1 hour	RL 24			Negative, July 27.
Fourth series: Lice transferred from third series of louse-infected rabbits to healthy rabbits.	21	RL 17	June 28, 6 p. m.	47	3 days, after which 20 lice remained alive.	RL 27			Do.
	22	RL 14	June 29	20	About 3 hours	RL 26			Do.

[1] Died of pneumonia, June 17, on second day; his lice were then transferred to RL 18.